With the Compliments of

Dr. Engelmann.

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THE TRUE GRAPE VINES

OF THE UNITED STATES,

— AND —

THE DISEASES OF THE GRAPE VINES.

BY DR. G. ENGELMANN.

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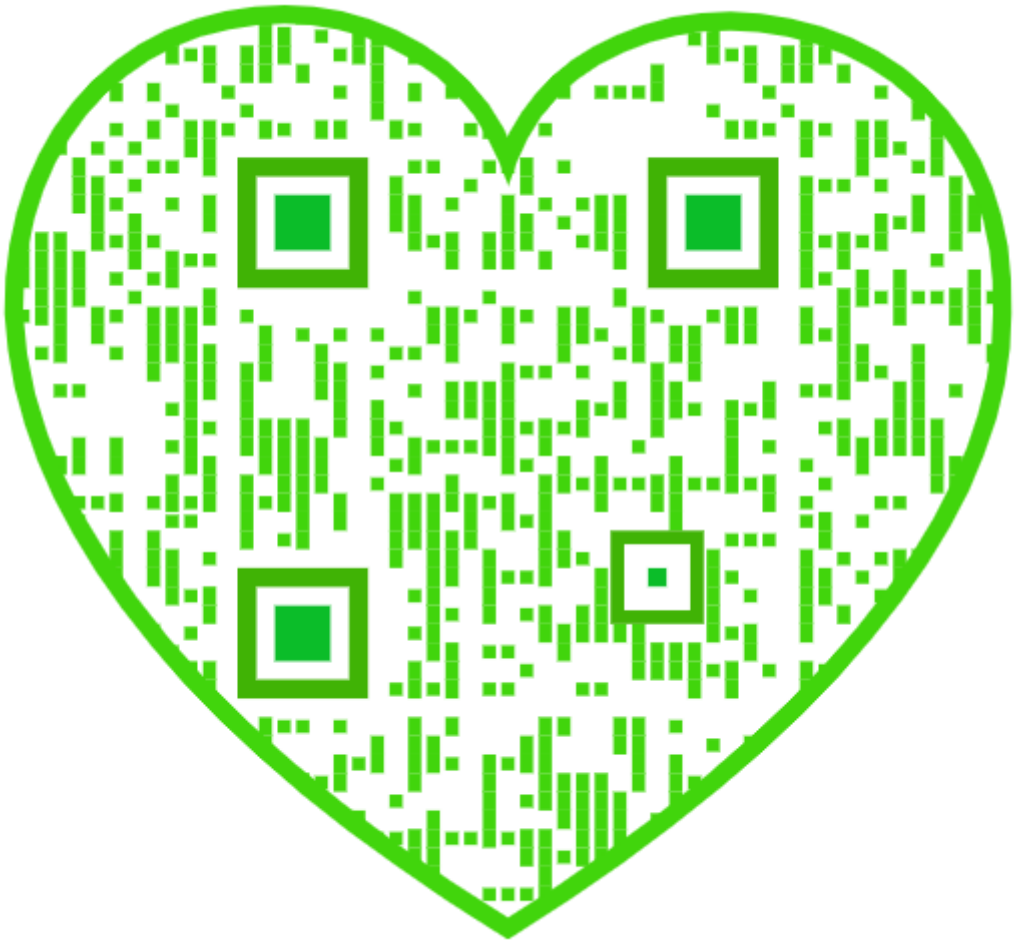
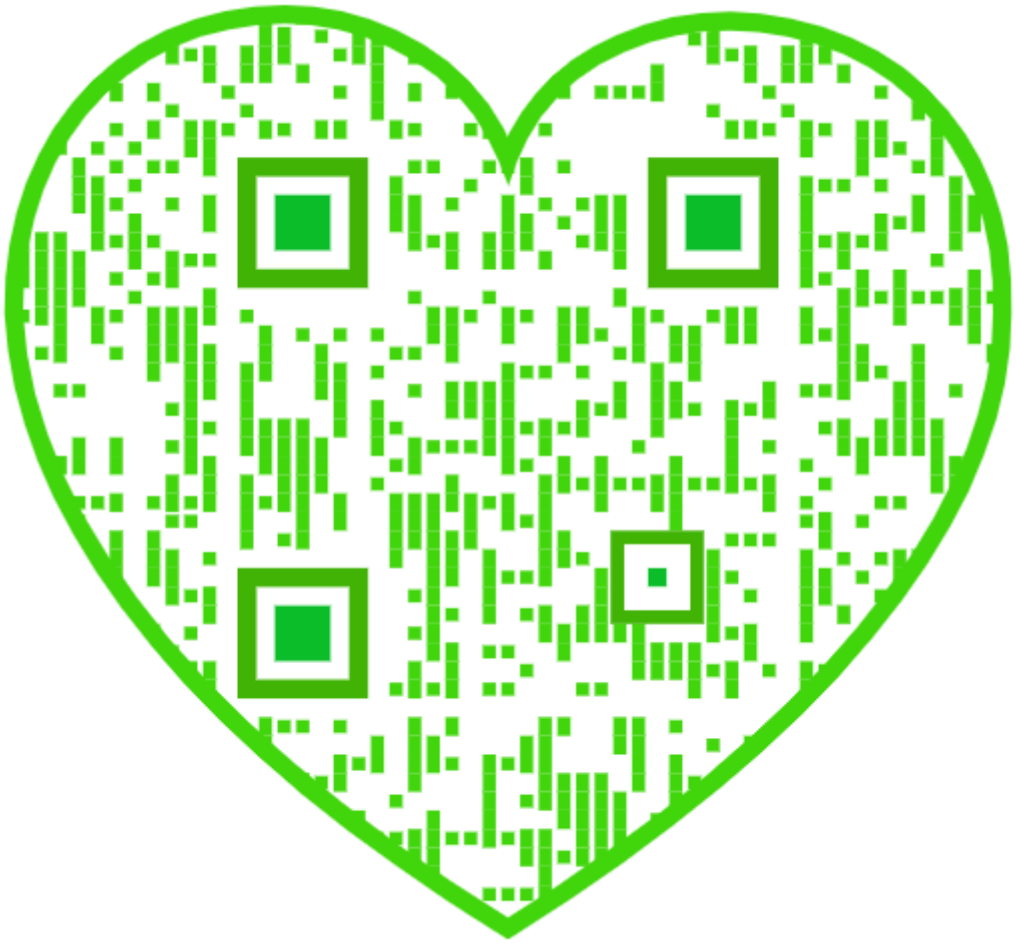
ST. LOUIS:
R. P. STUDLEY & CO., PRINTERS, LITHOGRAPHERS AND STATIONERS,
1883.





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The True* Grape-vines of the United States.

BY DR. G. ENGELMANN.

The Grape-vines are among the most variable plants, even in their wild state, in which climate, soil, shade, humidity, and perhaps natural hybridization, have originated such a multiplicity and such an intermixture of forms, that it is often difficult to recognize the original types and to refer the different given forms to their proper alliances. Only by carefully studying a large number of forms from all parts of the country, in their peculiar mode of growth and especially their fructification, or rather their seeds, are we enabled to arrive at any thing like a satisfactory disposition of these plants. (Table of Grape Seeds; fig. 1-33, page 13.)

Before I proceed to the classification of our Grape-vines, I deem it necessary to make a few preliminary remarks:

The grape-vines cultivated in that part of the United States lying east of the Rocky Mountains are all natives of the country, most of them picked up in the woods; some, perhaps, improved by cultivation; and a few the product of natural or artificial hybridization. In that part of the country the wine grapes of the Old World can only be cultivated under glass; but in New Mexico and California they have been successfully introduced by the Spaniards, and in the latter State a great many varieties are now extensively cultivated, and promise to make one of the great staples of that region; but eastward and northward they have entirely failed, owing to the destructive effects of that now so well known and dreaded insect, the Phylloxera, of which more, further on.

All the true Grape-vines bear fertile flowers on one stock, and sterile flowers on another separate stock, and are, therefore, called *polygamous*, or, not quite correctly, *diœcious*. The sterile plants do bear male flowers with abortive pistils, so that while they never produce fruit themselves, they may assist in fertilizing the others; the fertile flowers however, are hermaphrodites, containing both organs—stamens and pistils—and are capable of ripening fruit without the assistance of the male plants.† Real female flowers, without any stamens, do not seem ever to have been observed Both forms, the male and hermaphrodite, or if preferred, those with sterile and those with complete flowers, are found mixed in their native localities of the wild plants, but of course, only the fertile plants have been selected for cultivation, and thus it happens that to the cultivator only these are known; and as the Grape-vine of the Old World has been in cultivation for thousands of years, it has resulted that this hermaphrodite character of its flowers has been mistaken for a botanical peculiarity, by which it was to be distinguished, not only from our American Grape-vines, but also from the wild grapes of the Old World. But plants raised from the seeds of this, as well as of any other true Grape-vine, generally furnish as many sterile as fertile specimens, while those propagated by layering or by cuttings, of course, only continue the individual character of the mother-plant or stock.*

The peculiar disposition of the tendrils in the Grape-vines furnishes an important characteristic for the distinction of one of our most commonly cultivated species, *Vitis labrusca*, its wild and its cultivated varieties, from all others. In this species—and it is the only true *Vitis* exhibiting it—the tendrils (or their equivalent, an inflorescence), are found opposite *each* leaf, and this arrangement I designate as *continuous tendrils*. All the other species known to me exhibit a regular alternation of two leaves, each having a tendril opposite it, with a third leaf without such a tendril, and this arrangement may be named *intermittent tendrils*. Like all vegetable characters, this is not an absolute one; to observe it well it is necessary to examine well-grown canes, and neither sprouts of extraordinary vigor, nor

* We treat here only of the *true* grape-vines, with edible berries. In the flowers of these the small green petals do not expand, but cohere at the top, and separating from their base, fall away together as a little five-lobed hood. The flowers, and consequently the fruit, are arranged in the well-known clusters (thyrsus). Thus they are distinguished from the *false* grape-vines (botanically known as *Ampelopsis* and *Cissus*), which often resemble the true grape-vines very much, but bear no edible berries. Their flowers expand regularly, opening at top, and are arranged in broad, flat-topped clusters (corymbs).

† These fertile plants, however, are of two kinds; some are *perfect hermaphrodites*, with long and straight stamens around the pistil; the others bear smaller stamens, shorter than the pistil, which soon bend downward and curve under it; these may be called *imperfect hermaphrodites*, approaching females, and they do not seem to be as fruitful as the perfect hermaphrodites, unless otherwise fertilized.

It is proper here, to insist on the fact that nature has not produced the male plants without a definite object; and this object, without any doubt, is found in the more perfect fertilization of the hermaphrodite flowers, as it is a well established fact that such cross fertilization produces more abundant and healthier fruit. Vine growers might take a hint from these observations, and plant a few male stocks in their vineyards, say 1 to 40 or 50 of their fertile stocks, and might expect from such a course healthier fruit, which would probably resist rot and other diseases better than fruit grown in the ordinary way. I would expect such beneficial influence especially in all varieties that have short stamens, such as the Taylor. Male stocks can be easily obtained, either in the woods or from seeds. It is of course understood that the males ought to belong to the same species (or better, to the same variety) as the fertile plants to be benefitted by their pollen. European vine growers may also profit by this suggestion.

* Some observations (rather loose, to be sure) seem to point to the possibility of the sexual characters of the grape-vines becoming changed under certain circumstances; and, though I have not seen a case of this kind myself, nor heard of an instance where fertile vines in cultivation began to bear sterile (male) flowers, there is no absolute impossibility in it, as we know that other plants (willows for example) occasionally sport in this manner.

stunted autumnal branchlets. The few lowest leaves of a cane have no opposite tendrils, but after the second or third leaf the regularity in the arrangement of the tendrils, as above described, rarely fails to occur. In weak branches we sometimes find tendrils irregularly placed opposite leaves, or sometimes none at all.

It is a remarkable fact, connected with this law of vegetation, that most Grape-vines bear only two inflorescences (consequently two bunches of grapes) upon the same cane, while in the forms belonging to *Labrusca* there are often three, and sometimes, in vigorous shoots, four or five, or rarely, even more in succession, each opposite a leaf. Whenever in other species, in rare cases, a third or fourth inflorescence occurs, there will always be found a barren leaf (without an opposite inflorescence) between the second and third bunches.

Another valuable character, discovered by Prof. Millardet, of Bordeaux, is found in the structure of the branches ("canes," as they are usually called). These contain a large pith, and this pith is transversely separated at each node (point where a leaf is or has been inserted), by what is called a diaphragm. These diaphragms consist of harder, solid pith, of the appearance of wood, and are examined best in canes 6 to 12 months old, when the pith has turned brown and the diaphragm is whitish; A longitudinal section through the cane will best exhibit them. They are, in most species, 1 to 2 lines thick; but in the Riverbank grape, *Vitis riparia*, the diaphragm is not more than $\frac{1}{8}$ to $\frac{1}{4}$ line thick; and in the Sand, or Rock grape, *Vitis rupestris*, it is very little thicker. For us here, the distinction of these species is of no great practical importance; but, as a considerable demand for them has sprung up in Europe, it is well to characterize them accurately; and this character holds good in winter, when all others of foliage or fruit have disappeared. There is only one American Grape-vine, also in other respects an aberrant form, the Southern Muscadine grape, *Vitis vulpina*, which is entirely destitute of such diaphragms.

The cut represents the diaphragms of different species. Fig. 34, *Vitis riparia*, with the thinnest, and fig. 36, *Vitis cordifolia*, with a thick diaphragm; *Vitis œstivalis*, is similar to this last, and *Vitis labrusca* scarcely thinner; but fig. 35, *Vitis rupestris*, has a diaphragm not much thicker than the first. Fig. 37 shows *Vitis vulpina* without any partition.

It is well known that some species of *Vitis* grow well from cuttings, while others are difficult to propagate in this way.

Easy to propagate are *Labrusca*, *Monticola Riparia*, *Rupestris and Palmata*. Almost im-

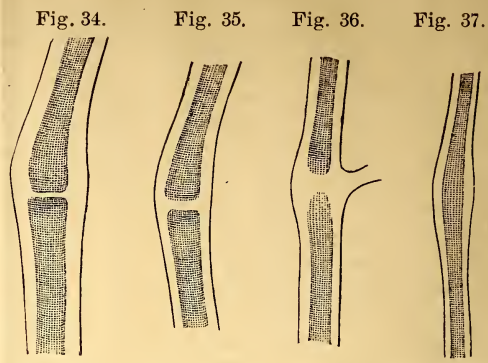


Fig. 34. Fig. 35. Fig. 36. Fig. 37.

V. riparia. V. rupestris. V. cordifolia. V. vulpina.

possible to propagate by cuttings are *Candicans*, *Æstivalis*, *Cinerea*, *Cordifolia*, *Vulpina*, and probably *Californica*. *Arizonica and Caribea* I do not know in this respect. That the southern cultivated forms of *Æstivalis* grow more or less readily from cuttings is stated further on (page 16).

The structure of the bark of the young canes shows also differences in the different species, but as the characters are to some extent of microscopical detail they are here omitted. The bark of the mature canes is ashy gray (*V. cordifolia*, *V. Cinerea*), to red or brownish *V. œstivalis*); it peels off after the first season in large flakes, or in narrow strips or shreds; only in the Muscadine grape the dark gray bark does not peel off at all, at least not for a number of years.

Young seedlings of all the Grape-vines are glabrous or only very slightly hairy. The cobwebby or cottony down, so characteristic of some species, makes its appearance only in the more advanced plants; in some of their varieties, and not rarely in the cultivated ones, it is mainly observed in the young growth of spring and is apt to disappear in the mature leaf; but even then such leaves are never shining as they are in the glabrous species, but have a dull or unpolished, or even wrinkled surface.

The form of the leaves is extremely variable, and descriptions must necessarily remain vague. They are usually cordate at base, either with an acute and narrow sinus (*V. cordata*, and many other species), or with a broad and wide one (*V. riparia* and *V. rupestris*). Leaves of seedling plants are all entire, i. e. not lobed; young shoots from the base of old stems, as a rule, have deeply and variously lobed leaves, even where the mature plant shows no such disposition. Some species (*V. riparia*), or some forms of other species (forms of *V. labrusca* and *V. œstivalis*), have all the leaves more or less lobed, while others exhibit, on the mature plant, always entire, or, I should rather say, *not lobed* leaves; the leaves of *V.*

rupestris and *V. vulpina* are never lobed. Only the leaves of flower-bearing canes ought to be considered as the normal ones.

The surface of the leaves is glossy and shining, and mostly bright green. or in *rupestris* pale green; or it is dull above and more or less glaucous below. The glossy leaves are perfectly glabrous, or they often bear, especially on the nerves of the lower side, a pubescence of short hair. The dull leaves are cottony or cobwebby. downy on both or only on the under side, and this down usually extends to the young branches and to the peduncles, but, as has been stated above, often disappears later in the season.

On both sides of the insertion of the petiole or leafstalk into the branchlet, we find on very young, just developing shoots, small accessory organs, which soon disappear; they are the stipules. In most species they are thin, membranaceous, rounded, at the top somewhat oblique, smooth in some, downy or woolly in other species. They are most conspicuous and elongated in *Vitis riparia*, in which I find them 2½-3 lines long; in *V. rupestris* they are 1½-2½ lines in length; in *V. candicans* and *Californica* scarcely shorter, in *V. labrusca* 1½-2 lines long; in *V. æstivalis, cordifolia*, and most others, they are only one line long or less; in very vigorous young shoots they may sometimes be larger, just as their leaves are also larger than the normal.

Not much of a distinctive character can be made out of the flowers. It is observed, however, that in some forms the stamens are not longer than the pistil, and very soon bend under it, while in other forms they are much longer than the pistil, and remain straight till they fall off. It is possible that those with short stamens are less fertile than the others.*

The time of flowering is quite characteristic of our native species, and it seems that the cultivated varieties retain herein the qualities of their native ancestors. The different forms of *Riparia* flower first of all; soon afterwards comes *Rupestris*, next *Labrusca* and its relatives, and later *Æstivalis* comes in bloom. One of the last flowering species is *Cordifolia*, and still later, *Cinerea*. *Vinifera* seems to flower soon after *Labrusca*, but it is not cultivated here, nor is *Vulpina*, which is probably the latest of all. *V. candicans* apparently blooms about the same time that *Labrusca* does.

Riparia begins to open its flowers about St. Louis three to five weeks earlier than the first blossoms of *Æstivalis* are seen in the same locality. In favorable situations and in early seasons they make their appearance in this vicinity as early as April 25th, at other seasons sometimes as late as May 15th, or even 20th, on the average about May 10th, and generally about the time when the Acacias (Black Locusts) bloom, both filling the atmosphere with the sweetest prefumes. *Cordifolia*, and, after this, *Cinerea*, on the contrary, bloom from the last days in May to (in late seasons) the middle of June, when that weed among trees, the fetid Ailantus (misnamed the tree of Heaven), exhales its nauseous odors and the beautiful Catalpa expands its gorgeous bunches of flowers. *V. palmata* (Vahl), of which we do not yet know much, seems to be the latest flowering Grape-vine with us, flowering even after *Cinerea*. Thus we are not likely to have any Grape-vines in flower *here* before April 25th or after June 20th.

One of the botanical characters of the Grape-vine is found in the *seeds*. The bunches may be larger or smaller, looser or more compact, branched (shouldered) or more simple, conditions which, to a great extent, depend on variety, soil and exposure; the berries may be larger or smaller, of different color and consistency, and contain fewer or more seeds (never more than four), but the seeds, though to some extent variable, especially on account of their number* and mutual pressure, where more than one is present, exhibit some reliable differences. The big top of the seed is convex or rounded, or it is more or less deeply notched. The thin lower end of the seed, the beak, is short and abrupt, or it is more or less elongated. On the inner (ventral) side are two shallow, longitudinal irregular depressions. Between them is a ridge, slight where there are one or two seeds, or sharper where the seeds are in threes or fours; along this ridge the *raphe* (the attached funiculus or cord) runs from the *hilum*, at the beak, over the top of the seed, and ends on its back in an elongated, oval or circular well-marked spot, called by botanists *chalaza*. This raphe is on that ridge represented by a slender thread, which on the top and back of the seed is entirely indistinct, or scarcely perceptible, or it is more or less prominent, like a thread or a cord. In our American species these characters seem pretty reliable, but in the varieties of the Old World Grape-vine (*Vinifera*), several thousands of years removed from their native sources, the form of the seed has also undergone important

* Compare note on page 4.

*A single seed is always thicker, plumper, more rounded; two seeds are flattened on the inner, rounded on the outer side; three or four seeds are more slender and angular; these different variations may often be found in berries of the same bunch.

modifications, and can no longer be considered so safe a guide as in our species.

But different as these seeds are among themselves they have a character in common, which distinguishes them from all our American Grape seeds; their beak is narrower and usually longer, and their large chalaza (the area on the back of the seed) occupies the upper half and not the centre of the seed; in the American species the beak is shorter and more abrupt; the chalaza, usually smaller, and often not circular, but narrower, is placed in the centre of the back. Any one who wishes to satisfy himself of this need only compare a raisin seed with any of our grape seeds, if the following cuts are not plain enough.

The size and weight of the seeds varies greatly in the different species, thus *Labrusca* and *Candicans* have the largest, *Cinerea* and *Riparia* the smallest seeds, but even in the wild state we find variation, e. g., in *Æstivalis*, still more in *Cordifolia*, and most in *Riparia*. In *Vinifera*, the European grape, however, the variations are much greater, greater even some times than our figures show. Some have laid stress on the color of the seeds, which varies between brown and yellowish, but that seems to me to go too far for our purposes.

The cuts of 33 Grape seeds, here represented, illustrate the different characters which have been mentioned above. The figures are magnified four times (four diameters), accompanied by an outline of natural size. They all represent the back of the seed.

Fig. 1 and 2, *Vitis Labrusca*, seeds of wild plants; fig. 1 from the District of Columbia, and fig. 2 from the mountains of East Tennessee. The seeds of the cultivated varieties do not differ from these; they are all large, notched on top; chalaza generally depressed and no raphe is visible in the groove which extends from the chalaza to the notch.

Figs. 3 to 5 represent seeds of cultivated forms, which all show evident signs of hybridity and acknowledge the parentage of *Labrusca* by the form and size of the seed as well as by the irregular arrangement of the tendrils. Fig. 3 is the seed of the Taylor Grape, which stands near *Riparia*. Fig. 4 is the seed of the *Clinton*, which has, perhaps, the same parents. Fig. 5, seed of the *Delaware* Grape, which possibly may be a hybrid of *Labrusca* with *Vinifera*.

Figs. 6 to 8, *Vitis Candicans;* seed similar to those of *Labrusca*, but broader, generally with a shorter beak, and less distinctly notched. Figs. 6 and 7 are from Texas, the latter broader and with a broader beak; fig. 8 comes from South Florida, and is still broader and shorter.

Fig 9, *Vitis Caribæa*, similar to the last, but smaller; seeds short and thick, and deeply notched.

Figs. 10 and 11, *Vitis Californica*, seeds often smaller, scarcely or not at all notched, raphe indistinct or quite invisible; chalaza narrow and long. Fig. 10 represents a single seed (one only in a berry) from near San Francisco; fig. 11 is one of four seeds from San Bernardino, in Southern California.

Fig. 12, *Vitis Monticola;* seed very similar to those of the last species, thick, notched, without a distinct raphe, and with a long and narrow chalaza.

Figs. 13 and 14, *Vitis Arizonica*, from the Santa Rita Mountains; seeds small, slightly notched, with a more or less distinct but flat raphe.

Figs. 15 to 17, *Vitis Æstivalis;* seeds rather larger, cord-like raphe and more or less circular chalaza strongly developed; all the seeds are from wild grapes gathered about St. Louis; the seeds of the cultivated forms, Northern and Southern, are similar. Figs. 15 and 16 are from berries with only one or two seeds; fig. 17 is narrower, and from a larger four-seeded berry.

Fig. 18, *Vitis Cinerea*, a seed similar to the last, with the same strong raphe, but smaller in size, and often single.

Figs. 19 and 20, *Vitis Cordifolia;* seeds also similar to the two last, but raphe not quite so prominent, mostly single or in twos, rarely more in a berry; fig. 19 comes from a larger berry, with more seeds, found near St. Louis; fig. 20 is a single seed, from the District of Columbia.

Fig. 21, *Vitis Palmata;* seed large, almost globose, with a very short beak, a narrow chalaza, no raphe visible, top slightly depressed.

Figs. 22 to 25, *Vitis Riparia;* seeds similar to the last, but smaller, though quite variable in size. The seeds all come from wild plants; figs. 22 and 23, from Goat Island on the Niagara Falls; fig. 22 a single broad seed; fig. 23 from a three-seeded berry; fig. 24 from a two-seeded berry from the shores of Lake Champlain, in Vermont; fig. 25, seed of the June grape from the banks of the Mississippi below St. Louis. The seeds are obtuse, or very slightly depressed on top, chalaza rather flat, elongated and gradually lost in a groove which encloses the scarcely prominent raphe.

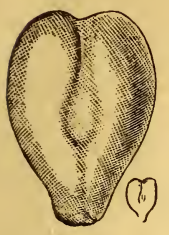
Figs. 26 and 27, *Vitis Rupestris;* fig. 26 from a two-seeded berry from Texas, and fig. 27 from a four-seeded one from Missouri. The top of the seed is obtuse, not notched, and the raphe very inconspicuous in the Texan seed, or invisible in that from Missouri.

Figs. 28 to 32, *Vitis Vinifera*, from the Old World. Different forms are introduced here for comparison with the American species, and to show how much they differ among themselves. Fig. 28 represents a seed out of a lot of grapes (or raisins) found with an Egyptian mummy, and probably now 3,000 years old, or older. The specimens are preserved in the Egyptian Museum of Berlin. The berry obligingly donated to me was as large as the larger European cultivated grapes, and enclosed three seeds. It will be seen that it is the largest of the *Vinifera* seeds figured here, showing perhaps a slight modification of the seed in the ages that intervened between its and our times.

Fig. 29, *Brusca*, the native species of Tuscany (Northern Italy), fig. 30, *Riesling*, cultivated on the banks of the Rhine; fig. 31, *Gutedel* (*Chasselas*), from the same region; fig. 32, *Black Hamburg*, from a grapery near London. All these seeds are easily distinguished from all American grape seeds, by the narrower and usually longer beak (or lower part), an

TABLE OF GRAPE SEEDS.

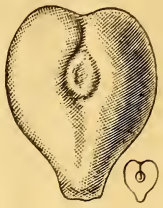
V. LABRUSCA. Fig. 1. Fig. 2.



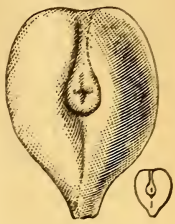
TAYLOR. Fig. 3.

CLINTON. Fig. 4.

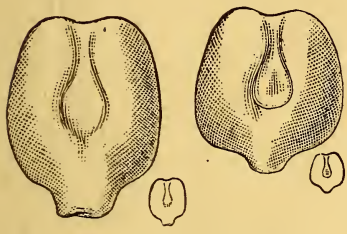
DELAWARE. Fig. 5.



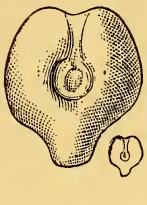
V. CANDICANS. Fig. 6.



V. CANDICANS. Fig. 7. Fig. 8.



V. CARIBEA. Fig. 9.



V. CALIFORNICA. Fig. 10.

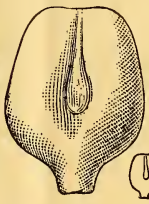
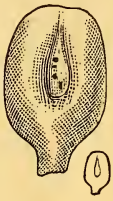
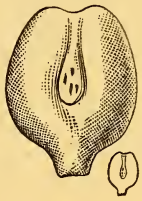


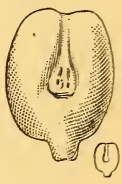
Fig. 11.



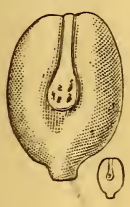
V. MONTICOLA. Fig. 12.



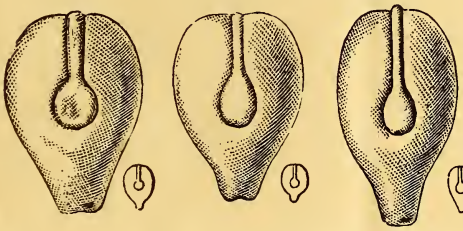
V. ARIZONICA. Fig. 13.



V. ARIZONICA. Fig. 14.

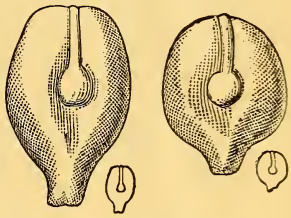


V. ÆSTIVALIS. Fig. 15. Fig. 16. Fig. 17.

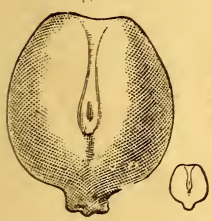


CINEREA. Fig. 18.

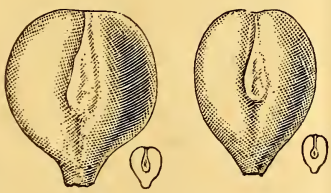
V. CORDIFOLIA. Fig. 19. Fig. 20.



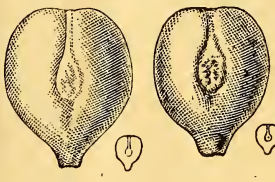
V. PALMATA. Fig. 21.



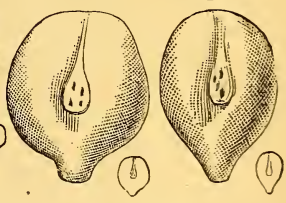
V. RIPARIA. Fig. 22. Fig. 23.



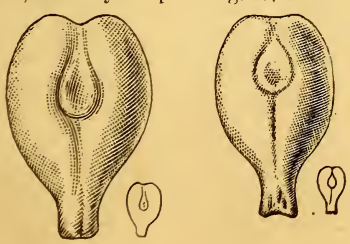
V. RIPARIA. Fig. 24. Fig. 25.



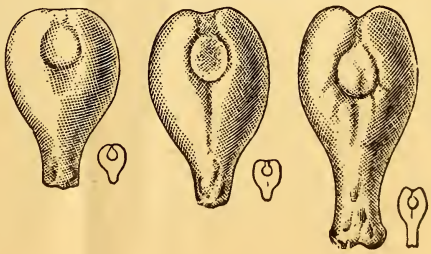
V. RUPESTRIS. Fig. 26. Fig. 27.



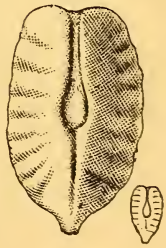
V. VINIFERA. Fig. 28, Mummy Grape. Fig. 29, Brusca.



VITIS VINIFERA. Fig. 30, Riesling. Fig. 31, Chasselas. Fig. 32, Bl. Hamb'g.



V. VULPINA. Fig. 33.



especially by the large circular, though not very prominent, chalaza, which occupies the upper, and not the middle part of the seed. These five specimen seeds represent the principal forms, but not all European grape seeds entirely agree with them.

Fig. 33, *Vitis Vulpina* (or *Rotundifolia*), from the South Carolina Muscadine grape, different from all other grape seeds, just as the plant differs from all the other Grape-vines; seed very flat, with straight sides, very short beak, wrinkled, or rather folded, on both surfaces, notched on top, with very narrow chalaza and no visible raphe.

The North American Grape-vines may be systematically arranged in the following order:

I. True Grape-vines, with loose, shreddy bark, climbing by the aid of forked tendrils, or sometimes (in No. 12) almost without tendrils.

A. Grape-vines with more or less continuous tendrils.

1. Vitis Labrusca, *Linnæus*, the northern Fox grape, the mother of a great many cultivated varieties and hybrids.

B. Grapevines with intermittent tendrils.

a. Leaves pubescent or floccose, especially on the under side and when young, often becoming glabrous with age.

* Raphe on seed indistinct.

2. Vitis Candicans, *Engelmann*. The Mustang grape of Texas.
3. Vitis Caribæa, *De Candolle*. The West India grape; rare in Florida.
4. Vitis Californica, *Bentham*. The California grape.
5. Vitis Monticola, *Buckley*, The Mountain grape of West Texas.
6. Vitis Arizonica, *Engelmann*. The Arizona grape

** Raphe on back of seed very conspicuous.

7. Vitis Æstivalis, *Michaux*. Summer grape of the Middle and Southern States, with several varieties.
8. Vitis Cinerea, *Engelmann*. The Downy grape of the Mississippi Valley.

b. Leaves glabrous, or sometimes short, hairy, especially the ribs beneath; mostly shining.

* Raphe on back of seed conspicuous.

9. Vitis Cordifolia, *Michaux*. Frost grape of the Middle and Southern States.

** Raphe indistinct.

10. Vitis Palmata, *Vahl*. Red grape of the Mississippi Valley.
11. Vitis Riparia, *Michaux*. Riverside grape of the United States and Canada.
12. Vitis Rupestris, *Scheele*. Rock or Sand grape of the Western Mississippi Valley and Texas.

Vitis Vinifera, *Linnæus*. The Wine-grape of the Old World and California; would find its systematic place here.

II. Muscadine grape, with (on the younger branches) firmly adhering bark, which only in the older stems scales off; aerial roots from inclined trunks in damp localities; tendrils intermittent, simple; berries very large (7–10 lines thick), very few in a bunch, easily detaching themselves at maturity; seeds with transverse wrinkles or shallow grooves on both sides.

13. Vitis Vulpina, *Linnæus* (Rotundifolia, *Michaux*). The Southern Fox grape or Muscadine.

Rafinesque, Le Conte and others, have in times gone by attempted to distinguish and characterize a good many more species, while on the other hand, Director Regel, of the St. Petersburg botanical garden, has lately tried, rather unnaturally, to contract them and unite them with Old World species. *Vitis vinifera* has resulted according to his views, from the hybridization of several of these species.

I now propose to give a short botanical account of the 13 species enumerated above, leaving to the author of this treatise the task to add the important practical remarks which the subject calls for.

1. Vitis Labrusca, Linnæus. Usually not large; climbing over bushes or small trees, occasionally reaching the tops of the highest trees; distinguished from all the other species, as has been stated above, by its continuous tendrils and consequently by its continuous (two to often four or six) clusters of flowers and fruit; stipules middle-sized, about two lines long, or less; leaves large (four to six inches wide), thick, of firm texture, entire or in some forms deeply lobed, very slightly dentate, coated when young with a thick rusty, or sometimes whitish down, which in the wild plant persists on the under side, but almost disappears in the mature leaf of some cultivated varieties; berries large in middle sized, or, in many cultivated forms, rather large bunches, bearing 2 or 3 or even 4 seeds, large, notched, without visible raphe. (See table of seeds, page 13, figs. 1 and 2.)

This species, usually known as the Fox grape, or Northern Fox grape, is a native of the Alleghany Mountains, and of their eastern slope to the sea-coast, from New England to South Carolina, where it prefers wet thickets or granitic soil. Here and there it descends along streams to the western slope of the mountains, but is a stranger to the Mississippi Valley proper.

As the *Labrusca* generally grows on granitic soil or granitic detritus, which may favor the vine, I would suggest to plant Catawba vineyards in the granitic regions of our Ozark Mountains, and would expect favorable results there.

By far the largest number of varieties of Grape-vines now cultivated in our country are the offspring of this species; a few produced by nurserymen, but most of them picked up in the woods; they are easily recognized by the characters above given, and most readily by the peculiar arrangements of the tendrils as above described. Large and downy-leaved varieties of *V. æstivalis* are, in the West and South-west, not rarely mistaken for *Labrusca*,

but the two may always be distinguished by the characters indicated.

It is also the species which has most generally been used as one of the parents (mostly the mother) in artificial hybridization, and as it is the most individualized or specialized of all our (perhaps of *all* known) Grape-vines, its characters unmistakably prevail in the hybrids, and rarely leave a doubt as to where to refer the questionable form; of which I shall have to add a few words below, under the head of *Hybrids*.

2. Vitis Candicans, Englemann. (*V. mustangensis*, Buckley.) The Mustang grape of Texas; a tall climber, with rather large, rounded, almost toothless leaves, white cottony on the under side, bearing large berries, which, like those of the wild *Labrusca*, show different colors, greenish, claret and bluish-black; and which, in its native country, are made into wine. In young shoots and sprouts the leaves are usually deeply and elegantly many-lobed, which, with the contrast of the deep green upper and pure white under surface, would make this species a most elegant vine for arbors, if it could be protected from severe frost. This may be done by laying it down and covering it with soil. In Texas it grows in the lower country, as well as on the calcareous hills, and extends even into the granitic region. It has also been found in Florida, where many Texas plants are again met with. The Florida form, at one time taken for Vitis caribæa, but quite distinct from it, has shorter and comparatively thicker seeds. (Fig. 8.)

3. Vitis Caribæa, De Candolle, is a West Indian species which has lately found its way, with other tropical plants, into southern Florida. It has a downy, cordate leaf, not lobed, but characterized by the small but very sharp, distant teeth. Its black berries are small and mostly bear but one or two seeds. I find the Florida seeds (fig. 9) which were kindly sent to me by Mr. A. H. Curtiss, the discoverer, larger than those of the West Indian type.

4. Vitis Californica, Bentham. The only wild grape of our Pacific coast; a low bush a foot or two high, in dry beds of streams in southern Oregon; it becomes a tall climber in southern California, with a stem 3 inches or more in diameter; it is distinguished by its cordate, rounded, whitish, downy leaves and small black berries in large bunches; the obtuse but scarcely notched seeds (figs. 10 and 11), without or with only a trace of a raphe, and with a narrow, long chalaza. No use is made of this species, but it has lately been recommended as a grafting stock for European vines in California vineyards which have been attacked by the Phylloxera. For even this Grape-vine, which is a native of a country originally entirely free from the insect, is as proof against it as any of our Mississippi Valley vines.

5. Vitis Monticola, Buckley. Usually a small bushy vine, rarely climbing over higher trees; branchlets angled; young stems, petioles and leaves cottony, downy, the down gradually disappearing, remaining only here and there in flocose bunches; stipules very short ($\frac{1}{2}$ line long); leaves deeply cordate, with a rounded sinus, very shortly three-lobed, edged with small but broad teeth, rather wrinkled on the upper surface, but the older ones very smooth and often conspicuously shining below (especially in the dry specimens); usually small, not more than three inches across, only on vigorous shoots three or four inches wide; tendrils intermittent, in the smaller, bushy forms, often withering away; bunches of fruit compact, short; berries 4, or rarely 5 lines in diameter; seeds obtuse or slightly notched, chalaza rather narrow, extending upward into a broad groove, but without a visible raphe.

This is one of the smaller species and is peculiar to the hilly, cretaceous region of western Texas, not extending to the lower country nor to the granitic mountains; common about San Antonio, New Braunfels, Austin, etc.; also occasionally cultivated about San Antonio, when the bunches, as well as the berries, become larger. This plant has given rise to a great deal of speculation and controversy. About fifty years ago, the Swiss botanist, Berlandier, collected it in West Texas,* but it was not till twenty-five or thirty years later that Prof. Buckley named and published it. Unfortunately his description was so insufficient that no botanist could recognize the plant; only the Texans of those regions, who well knew "the little mountain grape," understood what he meant. Buckley's mention of a middle sized green, very palatable berry has misled French botanists to look for this plant among the numerous forms of *Labrusca*, and Prof. Planchon therefore changed the name to *Vitis Berlandieri*. In justification of Buckley's description it is now said that there exists a form of this species, especially about Fredericksburg and on the borders of the Llano Estacado, with somewhat larger, green berries, which I understand Mr. J. Meusebach is trying to find out,

* On his specimens I found the first Phylloxera galls, which, thus accidentally preserved, prove the existence of the insect in America (doubted, however, by no one now) long before it became known to science here or in the Old World, and also prove its existence as far south as Texas.

and to introduce into cultivation. The species will readily grow from cuttings.

6. Vitis Arizonica, Engelmann, is closely related to the last, and has similar seeds, but the flat raphe, though rarely prominent, is broad and sometimes inconspicuous; branchlets angular; leaves cordate, with a rather open, rounded sinus, not lobed, or with two short latent lobes; floccose, cottony when young; glabrous, thick, very rigid, and (especially on the upper surface) rough, when older; berries small or middle sized, reported to be of luscious taste.

7. Vitis Æstivalis, Michaux. Climbing over bushes and small trees by the aid of forked, intermittent tendrils; branchlets rounded, bark of the mature ones mostly red, and scaling off in large flakes; leaves large (4–5 or 6 inches wide), of firm texture, entire, or often more or less deeply and obtusely 3–5 lobed, with rounded sinus and with short and broad teeth; when young always very woolly or cottony, mostly bright red or rusty; at last smoothish but dull, pale or glaucous beneath, and never shining; stipules very short and rounded, mostly rusty-downy; berries middle-sized, black, 5–7 lines, in Southwestern forms even 8–9 lines in diameter, coated with a bloom, when well grown in compact, often cylindrical bunches; seeds rather large, mostly two or three in each berry, rounded on top, showing a very prominent, cord-like raphe, and more gradually attenuated into the beak than is common in our species.

This is the well known summer grape, common throughout the Middle and Southern States, usually found on uplands and in dry, open woods or thickets, maturing its fruits in September. It is one of the most variable of our Grape-vines, and hence has seduced many into the establishment of numerous nominal species, while others, and among them myself, have assumed too wide limits for the species, and have classed under it forms which now, since we know them better, have to be kept separate. Among the latter I mention *V. monticola* and *V. cinerœa*, which are described in their proper places. Among the former I must still retain with *V. œstivalis* the form that had been distinguished by Buckley as *V. lincecumi*. This latter, often more bushy than climbing, has larger berries, leaves often deeply three-to-five lobed, and coated with a thick rusty down, or tomentum, which is often quite persistent. Forms with very large, woolly leaves have often been taken for *Labrusca*, and this species, abounding in the sandy post-oak (Quercus stellata) woods of Eastern Texas, and there known under the name of Post-oak grape or Sand grape, but extending also to Arkansas and Missouri, has thus been quoted for the Western and Southwestern States, to which the true *Labrusca* is an entire stranger.

This species is one of the most important ones for us, and in the West at least, has already taken the place once accorded to the Labrusca forms in our cultures, not only for their greater, aye absolute, resistance to the Phylloxera, but also for their intrinsic value as wine (and even table) grapes, notwithstanding the superior size of the Labrusca berries. Unfortunately the typical forms cannot be propagated by cuttings, and there are a number of varieties which, originating from a Southern home, are not quite hardy here, but, on the other hand, have the advantage of being readily propagated by slips, in some favorable localities. Their leaves are thinner than those of our type, and woolly only in the first youth; the bunches are larger, more shouldered; the berries, though small, are much sweeter and more juicy. They comprise among others the *Cunningham*, with less divided, and the *Herbemont* and the *Lenoir* with deeply lobed leaves, the two former with lighter colored, the latter with deep black berries. Unfortunately no wild plant from which these varieties might have sprung is yet known, but must be looked for in the mountains or hills of the Carolinas and Georgia, and only when found in a wild state can we correctly judge of their botanical status. About their viticultural relations, the body of this work has to be consulted. I will only state here that a slight suspicion exists of their being hybrids between *V. œstivalis* and some form of *vinifera*, though the seeds are entirely those of the former, and also the resistance to Phylloxera. The variety *Lenoir*, often named *Jaquez*, and in Texas *Black Spanish*, has been introduced by millions into Southern France, and is there found to furnish not only an excellent stock whereon to graft their own vines, but also to make a superior wine directly, and one very rich in the deep coloring matter so highly prized there.

8. Vitis Cinerea, Engelm., closely allied to *Æstivalis*, with which I had formerly united it as a variety, of pretty much the same size, rarely taller. It is distinguished by its whiteish or grayish pubescence, which, especially on the branchlets, is quite persistent, even into winter; by the angular branchlets, the hair being especially developed on the angles; the cordate often entire, or slightly three-lobed, more or less gray-downy leaves, which

often resemble a Lindenleaf, with a rounded but usually rather narrow sinus; by the large, loose inflorescence, which opens its flowers rather later than any other of our species; by the small black berries, about four lines in diameter, without a bloom, of a pleasantly acid taste, until frost sweetens them, and by the small, plump seed with a short beak.

This species is found in rich soil in the Mississippi Valley from Central Illinois to Louisiana and Texas, especially in bottom lands and along the banks of lakes. in situations where we scarcely ever meet with *Æstivalis*. It is quite abundant in such localities near St. Louis.

9. Vitis Cordifolia, Michaux. This is the tallest of our climbers at home in our deep bottom woods, but often also a low trailer over bushes and hedges, well known as the Winter, or Frost grape, flowering late and maturing late its strongly flavored, shining black berries.

The plant is glabrous, or the branchlets and lower surface of leaves somewhat hairy; branchlets indistinctly angular (in this respect intermediate between the last two species); diaphragm at the nodes of the branches thick, rarely, at the lower nodes, wanting; leaves rather large, three to four inches wide, or more, not lobed at all, or slightly three-lobed, cordate, with a deep narrow, or wider, but always sharp sinus, margined with conspicuous, rather large sharp-pointed teeth; stipules short; flowers in large, usually loose clusters, blooming rather late; berries small (three to four lines through), black and shining, with a peculiarly disagreable and strong flavor; edible only after frost; seed, with slight or strong raphe.

A common plant from the Middle States southward to Texas; not known, I believe, in northern New York or New England, but not rare in Pennsylvania and New Jersey, and found also near the city of New York; very common in the deep soil of the western river valleys, where it takes its fullest development. There the trunk sometimes reaches thirty to thirty-eight inches in circumference (southern Missouri, along the Iron Mountain Railroad); whether the trunk found by Mr. Ravenel at Darien, Georgia, measuring forty-four inches around, belongs to this species, I cannot tell, but his supposition that it was *Æstivalis* is quite improbable; the statement of newspapers that a Grape-vine in Gulf Hammock, in Florida, had a circumference of sixty-nine inches, is considered a "fish story" by Florida botanists.

The acute, mostly narrow sinus of the leaves, the small stipules, the broad diaphragms, the character of the seeds, the circumstance that it don't grow from cuttings, and the late flowering time, abundantly distinguish this species from *Vitis riparia*, with which it has been thrown together so long and so obstinately.

10. Vitis Palmata, Vahl, has been cultivated in the Jardin des Plantes in Paris for perhaps one hundred years or more, and has thence found its way into other European gardens, without, however, as it seems, having attracted the attention of botanists, since its first publication, in 1794.

Vahl's description is accurate enough, with the exception of its native country, which he gives as "Virginia," a negligence or ignorance which we must not criticise too severely in botanists of a century ago. The seed was originally brought to Paris probably by French missionaries, who, as is well known, roamed about in the Mississippi Valley one and two hundred years ago. Soon after the publication of Vahl's description of this grape, above mentioned, Michaux discovered this interesting species "growing abundantly on the banks of the streams in Illinois," and named it *V. rubra*. He don't seem to have recognized the vine which he might have seen growing under his eyes in Paris, and eventually he merged his specimens of this Vitis in his herbarium under *V. riparia*.

Last fall Mr. H. Eggert, of St. Louis, re-discovered this long neglected plant on the banks of the Mississippi, opposite Alton, and collected it there again this summer, when it proved to be the latest blooming of all our species (far from blooming yet to-day, June 10th). There can be no doubt of the identity of this plant with Vahl's *V. palmata* and Michaux's *Rubra*, nor of its entire distinctness from *Riparia*. It is found, with this last one, covering willow thickets and other bushes in low grounds, overflowed during high water. Its bright red branches, from which the bark separates in large flakes, conspicuous between the smooth but dull, darkish foliage (much darker than *Riparia*), show at once how appropriate Michaux's name is. The diaphragms are thick. The leaves have a broad sinus, and are shallow or often deeply three, rarely five, lobed, the lobes usually drawn out into long and slender points; the under side is often somewhat hairy along the nerves; stipules middle sized, 1½ to 2 lines long; flower bunches large and loose, on long stems; berries rather small (4–5 lines through), black, without bloom; seeds one or two, very large and plump, rounded, with very short beak, notched on top, without a visible raphe.

Our plant is readily distinguished from *Riparia* by the thick diaphragm, the red branches, its late flowering and its bloomless, late ripening berries; from *Cordifolia* the form of the leaves and of the seeds, and its ready growth from cuttings, easily separate it.

11. Vitis Riparia, Michaux, the Grape-vine of the river banks, has lately acquired a great deal of importance, as it has now become the principal Grape-vine relied on in France for the renovation of their failing vineyards, for which its vigorous growth, adapted to almost all climates, its perfect resistance to the insect, its easy growth from cuttings, and its ready taking of grafts, seem to peculiarly fit it.

This species climbs over bushes and small trees, or trails over the rocks on our river banks. It is also found inland, always near water, on larger trees, where its trunk may become six inches thick. The branchlets are rounded, not angled; the diaphragms very thin ($\frac{1}{8}$ to $\frac{1}{4}$ line thick); the stipules large (2–3 lines long) and very thin, and persist longer than in most other species; leaves of a light green, shining, glabrous or often hairy below, with a wide, rounded, or even truncate sinus; they are more or less tri-lobed, margined with large, sharp-pointed teeth. The bunches are mostly small and compact; berries small (four or rarely five lines in diameter), black, with a bloom, sweet and very juicy, scarcely pulpy; seeds (figs. 22 to 25) obtuse or slightly notched, with a narrow chalaza, raphe indistinct or very thin.*

It has the widest geographical distribution of any of our Grape-vines, and is the hardiest of them all. It extends northward to Lake St. Jean, ninety miles north of Quebec, and to the banks of the Upper Mississippi in Minnesota, and the shores of Lake Superior; in the South it is common on the banks of the Ohio and in Kentucky, Illinois, Missouri and Arkansas,† and in the Indian Territory. I have not seen it from Louisiana or Texas, but a form of it is found in the Rocky Mountains of Colorado and New Mexico, and perhaps in southern Utah. It is the earliest flowering species about St. Louis, according to season, between April 25th and May 15th, and matures earlier than any other. In St. Louis it used to be brought to market, before we had cultivated grapes, sometimes as early as July 1st, from the rocky, sun-exposed banks of the river below town, and was, indeed, known as the "June Grape." From that time on ripe fruit is found, according to locality, through August and September. It is singular that our vintners, as far as I can learn, have never made wine from this species, nor tried to cultivate and improve it. The berries probably seem too small, and they may have expected better results from the larger fruits of *Æstivalis*; but the experiment might yet be made, and our woods might be examined for larger-fruited varieties, which really do occur, e. g., along the Lakes and on Niagara, near Detroit, etc.

As has been stated above, this species has been confounded with *Vitis cordifolia*, to which indeed, it bears a certain resemblance; but the characters enumerated, especially those of the diaphragms, the stipules, the form of the leaf and its base, its flowering time, and above all the seeds, distinguish them as well as any two species can be distinguished, even if the difficulty of one and the readiness of the other to grow from cuttings be not taken into account.

12. Vitis Rupestris, Scheele, mostly a low, bushy plant, often without any, or with weak, deciduous tendrils, and not climbing, under favorable circumstances becoming stouter and climbing pretty high; branchlets rounded, diaphragm thicker than in *Riparia*, but thinner than in other species; leaves rather small (about three inches wide), broadly cordate, rarely very slightly lobed, mostly broader than long, usually somewhat folded together, with broad, coarse teeth, and commonly with an abruptly elongated point, glabrous, shining, of a very pale green color; stipules almost as large as in last species, 2–2½ lines long, thin; berries small or middle-sized, sweet, and in very small bunches; seeds obtuse, with a slender or almost invisible raphe.

This Grape-vine, of very peculiar aspect, is a native of the hilly country west of the Mississippi river, from the banks of the Missouri to Texas, and is also found on the Cumberland river near Nashville; its favorable localities are gravelly banks or bars of mountain streams, overflowed in spring, more rarely (in Texas)

* The French now distinguish several types of Riparia, differing somewhat in their minor characteristics. See our Viticultural Remarks.

† A peculiar form of *Riparia* is a plant which I found fifteen years ago in the botanic garden of Berlin, under the name of *Vitis Solonis*, and about the history of which nobody seems to have known any thing. Lately this plant has been taken up in France with that zeal so characteristic to that nation, as something possibly of particular interest for their viticultural pursuits. It is distinguished from the ordinary form by the long and narrow, almost incised, crowded teeth of the scarcely three-lobed leaves. The name is undoubtedly a corruption of "Long's," and the plant comes from the Upper Arkansas river, where Major Long, on his return from his expedition to the Rocky Mountains, found, as he reports, such excellent grapes. Seeds may have been brought home and the plant raised as "*Long's*." A manuscript of the viticulturist Bronner, preserved in the Carlsruhe library, speaks of a certain grape-vine as "*Longs, from Arkansas*," and it is reported that *Long's* is still growing in the late Mr. Bronner's garden at Wisloch, near Heidelberg, and that it is identical with *Solonis*. As an example of curious speculative interpretation it may be stated that some viticulturist had read *Solonis* for *Zanis* (an oriental grape), and *Arkansas* for *Caucasus*.

on rocky plains. In Missouri it is called Sand grape, in Texas often, on account of its luscious fruit, Sugar grape; with us it flowers soon after Raparia and ripens in August, and is said to make a good wine. In France the *V. Rupestris* is used, like the last species, as a grafting stock for French vines; it grows easily from cuttings, and is said to make vigorous plants, perfectly resistant to the insect.

Vitis Vinifera, Linnæus. Here would be the place to introduce the Grape-vine of the Old World, as it is most nearly allied to the last enumerated species, especially to *V. riparia*. Though many of its cultivated varieties bear berries as large, or even larger, than those of any of our American Grape-vines, other cultivated forms, and especially the true wine-grapes, those from which the best wines are obtained, and also the wild or naturalized ones, have fruit not much larger than that of the above named native species.

This plant, together with the wheat, belongs to those earliest acquisitions of cultivation, the history of which reaches beyond the most ancient written records. Not only have the sepulchres of the mummies of ancient Egypt preserved us its fruit (large sized berries) and seed, but its seeds have even been discovered in the lacustrian habitations of Northern Italy. It is a mooted question where to look for the native country of this plant, and whether or not we owe the different varieties of our present *Vinifera* to one or to several countries, and to one or to several original wild species, which, by cultivation through uncounted ages, and by accidental and repeated hybridization, may have produced the numberless forms now known. These remind us forcibly of the numerous forms of our dog, which we cannot trace, either, but which can scarcely be derived from a single (supposed) original wild species. Director Regel, of St. Petersburg, ascribes them to the intermingling of a few species, well known in their wild state at this day. The late Prof. Braun, of Berlin, suggested that they are the offspring of distinct species yet found wild in many parts of Southern Europe and Asia, which thus he considered not the accidental offspring of the cultivated plants, as is generally believed, but the original parent stock. I may add, from my own investigations, that the Grape-vine which inhabits the native forests of th low banks of the Danube, "bottom-woods," as we would call them, from Vienna down into Hungary, well represents our *V. cordifolia*, with its stems three, six and nine inches thick, and climbing on the highest trees, its smooth and shining, scarcely lobed leaves, and its small, black berries. On the other hand, the wild grape of the thickets of the hilly countries of Tuscany and Rome, with its lower growth, somewhat cottony leaves, and larger and more palatable fruit, which "don't make a bad wine," as an Italian botanist expressed himself to me, reminds us, notwithstanding the smaller size of the leaves, of the downy forms of *Riparia*, or perhaps of some *Æstivalis*. It was known to the ancients as *Labrusca*, a name improperly applied by science to an American species, and is called by the natives to this day *Brusca*. The Grape-vines of the countries south of the Caucasus Mountains, the ancient Colchis, the reputed original home of these plants, greatly resemble the Italian plant just described.

The European Grape-vine is characterized by smoothish, and, when young, shining, more or less deeply, five or even seven-lobed leaves; lobes pointed and sharply toothed; seeds mostly notched at the upper end; beak elongated; raphe indistinct; chalaza broad, high up the seed. In some varieties the leaves and branchlets are hairy and even downy when young; the seeds vary considerably in thickness and length, less so in the shape of the raphe. It is well known that the plant grows readily from cuttings, and that it easily and almost invariably succumbs to the attacks of the Phylloxera, which, accidentally introduced into France, probably with American vines, has done such immense damage in that country and in the rest of Europe, probably since 1863 (though only discovered as the virulent enemy in 1868), and is spreading more and more. In California, where thus far the *Vinifera* has been successfully cultivated, the insect also begins to make its appearance in some localities. That it was the cause of the complete failure in all the efforts to plant the European vine east of the Rocky Mountains, is now well known.

13. Vitis Vulpina, Linnæus (known also as *V. rotundifolia*, Michaux), the *Southern Fox grape*, *Bullace* or *Bullit grape*, or *Muscadine* of the Southern States, is entirely different from all our other Grape-vines, and is mentioned here only to complete the list of our species. It is too tender for our climate, and never flowers or fruits here. It is found in damp thickets or on mountain slopes, sometimes a low bush, and again climbing very high, with entire, never forked, tendrils; branchlets without any diaphragm (see fig. 37); leaves small (two, or at most, three inches wide), rounded, heart-shaped, firm and glossy, dark green, smooth, or rarely slightly hairy beneath, with coarse and large or broad and bluntish teeth. The bunches are very small, of few very large berries, which fall off singly, like plums. The peculiar seed has been figured and described above (page 13, fig. 33). In the South some of the varieties are highly esteemed, especially the White Scuppernong.

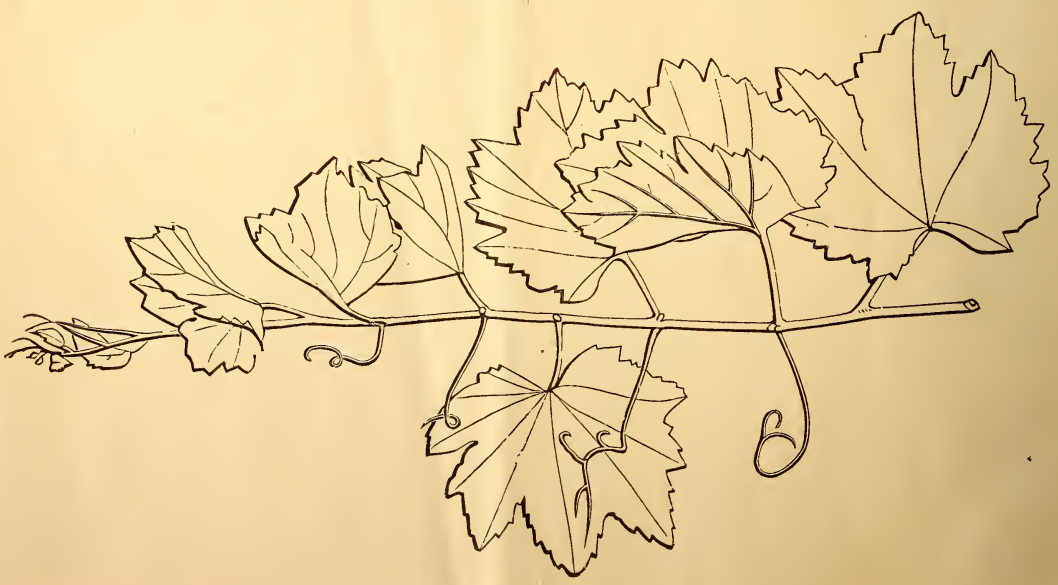
HYBRIDITY.

Plants, which are so intimately related among themselves, are apt to hybridize, and their offspring is usually fertile, not like many hybrid animals (the mule) or plants incapable to propagate. We have a number of artificial hybrids among Grape-vines, whose history is well known, and which bear as well as the true species, and their seeds are fertile. But we also find other vines in the woods or in vineyards, which, from their characters, we must conclude to be spontaneous hybrids. There is, of course, a good deal of experience and judgment necessary to decide what may be

justly claimed to be a hybrid, and what only a variety within the limits of some variable species, and the opinions of different persons may honestly vary on these points. But whoever has studied the great variability of many plants will hesitate long before he calls to his aid the often fanciful help of hybridity in the explanation of doubtful forms. Where species are so well marked as e. g. *Labrusca* is, it is not difficult to recognize some of its characters in a hybrid off-spring, though the general looks of the questionable plant otherwise may not conform to our idea of *Labrusca* at all; but in other cases, where species already stand near one another, the matter becomes much more difficult. But there is another way, unfortunately a very tedious one, to assist in such investigations, viz: to sow the seeds of hybrids and study their offspring; for it is a fact that seedlings of hybrids are apt to revert to, or at least to approach to, one or the other of the parents. One of the most striking examples of both positions here taken is furnished by the well-known Taylor or Bullit grape. The vigorous growth of this form, its thin diaphragms, its glossy, glabrous foliage, its small clusters of rather small berries entirely destitute of foxy taste, all seem to point to it as a cultivated variety of *Riparia;* but when we come to examine the tendrils we find that they are irregular; sometimes intermittent, sometimes more or less continuous (I have seen six in succession, which can only point to *Labrusca*), and just so the seeds differ from *Riparia* seeds by their great size and their form (see page 13, fig. 3). Now it so happens that Taylor seeds have been planted by the million in Europe, in order to raise resistant stock for grafting, and the general experience is that one cannot find two seedlings in a hundred alike, and similar to the mother-plant; some approach the *Riparia* type, and others show the *Labrusca* parentage distinctly. Thus, to give only one example, one of such seedlings—the now frequently cultivated *Elvira*—is a Taylor seedling with a close approach to *Labrusca*.

It would further the study of our Grapevines considerably if some of those that have the zeal, the leisure and the opportunity, would institute such experiments with doubtful forms.

Pursuing this interesting subject further, I may add that where nearly allied species grow near together, and bloom about the same time, they are more likely to hybridize than such species that are separated by wide space or different period of flowering. With all these considerations we must not forget that with the innumerable opportunities given every where for hybridization we find comparatively so few spontaneous hybrids in the vegetable world. Hybridization is an abnormal, I may say, an unnatural process, which is usually prevented by countless obstacles. If it were not so, we would meet with more hybrids in our woods and prairies than with genuine species; but how rare are they, and what a find it is for a botanist to discover one! And this is the more to be wondered at, because the genital organs of the plants, though mostly united in one flower, are usually so organized that self-fertilization is made difficult, or is excluded, and that cross-fertilization is the rule. We may put it down as a law that honest nature abhors hybridization.



are principally occasioned by animal or vegetable parasites. I leave others, who are more conversant with the subject, to treat of the former, and will merely state here that our species have all grown up with the Phylloxera, and would have long ago been extinguished, or rather never could have lived, if that insect had such power over them; but they as well as the insect live on, the latter having no other nourishment than the grape-vines and their roots: you may call it an accommodation between them.

More important for us in America are the fungus diseases, which do our grape crops more harm than the Phylloxera. It is said that in Europe they have discovered over 200 kinds of fungi which live on the different parts of vines, but fortunately only a few of them are really injurious. These are, above all, the mildew of the leaves and the black rot of the berries. In Europe they have, besides our mildew, which has lately been introduced, the Oïdium and the Anthracnose.

The *Mildew*, *Peronospora viticola*, appears in frost-like white spots on the under side of the leaves, hairy as well as glabrous ones, here in Missouri generally from the beginning of June, fostered by the sultry and damp or wet weather, usual at that season; in the Eastern States it seems to come on later in summer and in the fall. Though most common on the leaves, it sometimes also infests the petioles of the leaves, the stems of the bunches, and the very young berries. But, even if it does not attack the latter, the effects on the leaves alone, which turn brown in spots and are eventually partially or completely killed, destroys the fruit, the berries shrivelling *from the base*, turning light brown without falling off. This is here sometimes termed "brown rot."

The fungus at first pervades the cellular tissue of the leaf; then, a few days later, the minute fungus stems protrude through the stomats (breathing pores) of the lower surface, forming little upright branching plantlets, which might be compared to a miniature spruce tree, singly not visible to the naked eye; they bear at the end of the branchlets the summer spores (*conidia*), which mature, are discharged, spread by wind or otherwise, and, when moistened, germinate with astonishing rapidity. Late in the season the fungus produces what are called the resting spores (oospores) in the interior of the leaf-tissues, and, while the others propagate the parasite in summer, these larger and more enduring ones keep alive through winter and insure its growth in the following summer. Thus it is seen that the dead mildewed leaves, containing the resting spores, really do preserve the germs for the next season's mildew. These leaves ought to be destroyed by carefully gathering and burning them, or by burying them *deeply* in the ground. The direct destruction of the fungus has been often attempted, and by different means, especially by sulphur-sprinkling, but without any marked effect; a dry spell of weather, however, arrests it most effectually for the time being.

The *Peronospora* has since 1878 made its appearance in Europe — like the Phylloxera, accidentally introduced from this country — and has added another terrible infliction on the wine-growers there, which threatens to be worse than the Oïdium, which years ago used to decimate the grape crops of Europe.

A few words about this *Oïdium* may be in place here. This is a mildew-like fungus which appears on the *outside* of the *upper* surface of the vine-leaves, and bears its fewer spores on smaller, not much branched, stemlets; it destroys the vitality of the leaves, and with it the crop, just as our mildew does. Its resting spores are unknown and with its life-history we are not so well acquainted, but we know that sulphur sprinkled over the leaves will destroy it. It made its first appearance, as far as it is known, about 1845, in graperies at Margate, near London, and spread rapidly and destructively over a great part of Europe and the islands, especially Madeira, where the grape culture was almost annihilated by it; but it seems to be now less common or less injurious than it was years ago, and may possibly have run its course, just as other epidemics are apt to do. It is unknown where it originally came from; some suppose that it originated in America, but it has never appeared here in the form under which it is known in Europe; whether in another form, is still questionable among our best mycologists; at all events we have thus far only one destructive form of mildew here, the *Peronospora*.

The second great fungus pest of our vineyards is the *Black Rot*, *Phoma uvicola*. On the berries, but never on the leaves or stems, generally about the time that they are full grown, in July or August, very rarely on half-grown berries in June, a light brown spot with a darker central point is observed on the side and not near the stem; this spot spreads, and darker, shining nodules or pustules, plainly visible with the naked eye, begin to protrude above the epidermis; at last the whole berry shrivels up, turns bluish-black and the pustules roughen the surface, and each one opening at its top emits a whitish worm-like thread, which consists of innumerable spores glued together with a mucilaginous coating. In this condition the spores are inert, but rain will dissolve the mucilage and liberate and wash down the spores, or they will with the dead berries fall to the ground. What then becomes of them, whether they enter the soil, or how they propagate the fungus, is as yet unknown. At all events it seems advisable to gather all the affected berries, if such a thing can be done, and destroy them.

In Europe they have another fungus disease of the grape, called in Germany *Brenner*, in France *Anthracnose*, and described under the name of *Sphaceloma ampelinum*, which by some authorities has been supposed to be another form of development of our Black Rot, above described; this, however, seems very doubtful. We have, as it seems, never had the *Sphaceloma*, nor they the *Phoma*. The former attacks all the green parts, leaves, young stems, or green berries, and forms open wounds which might be compared to ulcers while our *Phoma* is restricted, as far as known, only to green berries, without breaking up the tissues or forming ulcers. The *Sphaceloma* seems to be an old disease in Europe, known already in the last century. Mycologists are now carefully studying these questions.